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1. Your reference — 50056 / P708883GB/DRC.LKH

2. Patent application number
(The Patent Office will fill in this part) — 0308013.2

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Prodrive 2000 Limited
Acorn Way
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Patents ADP number *(if you know it)* — 7929110001

If the applicant is a corporate body, give the country/state of its incorporation — England, UK

4. Title of the invention — Turbocharger

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

WITHERS & ROGERS
Goldings House
2 Hays Lane
London
SE1 2HW

Patents ADP number *(if you know it)* — 1776001

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Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

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Number of earlier application	Date of filing *(day / month / year)*

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Continuation sheets of this form	
Description	8
Claim(s)	3
Abstract	-
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Priority documents	-
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Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	-
Request for preliminary examination and search *(Patents Form 9/77)*	One
Request for substantive examination *(Patents Form 10/77)*	-
Any other documents *(please specify)*	-

11. I/We request the grant of a patent on the basis of this application.

Signature Without Prejudice Date 4 April 2003

12. Name and daytime telephone number of person to contact in the United Kingdom — David R Cowan — 01926 336111

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P708883GB

Turbocharger

This invention relates to turbochargers, in particular, but not exclusively a turbocharger unit for an internal combustion engine, and to internal combustion engines incorporating such a unit.

Turbocharging units have often been used to boost the air flow into internal combustion engines to improve performance. Such units have often suffered an inability to improve performance at low speeds and during the transition between light and full throttle settings of the engine.

An object of the invention is to provide an improved turbocharger unit which is capable of reducing the so called turbo lag of existing units.

According to one aspect, the invention provides a turbocharger unit for an internal combustion engine, the unit comprising a combustion chamber having an inlet for admitting exhaust gases from the internal combustion engine, an air inlet for admitting air into the chamber, and an outlet in communication with a turbine whereby to cause the gases from the chamber to drive a compressor, operation of the compressor generating a flow of air to the internal combustion engine, the chamber being arranged to cause combustion within the chamber of combustible products of the engine exhaust and/or other combustible products introduced into the chamber.

Preferably, the chamber is arranged to have an exhaust gas inlet region which increases in cross section in the downstream direction, a central obstruction member downstream of the inlet region, a central elongate member downstream of the obstruction and extending generally in the direction of flow of gases through the chamber and having air outlet means for introducing air into the chamber.

The unit may comprise a plurality of peripheral air outlet means whereby air is discharged at the outer periphery of the chamber.

The combustion chamber may be formed with an outer air chamber from which the air is arranged to pass into the combustion chamber from a plurality of openings.

Preferably, the central elongate member extends along the combustion chamber from the obstruction member towards the outlet end of the chamber and air is discharged from said elongate member into a combustion space in the combustion chamber, the space extending generally annularly around the elongate member.

The combustion chamber may be generally circular in internal cross-section and defines a generally annular region downstream from the exhaust gas inlet in which combustion takes place, air being introduced into the annular region from radially inner and outer locations, and air may be introduced through the walls of the combustion chamber in the region of the exhaust inlet and in the region of the exhaust gas outlet.

Usually the flow of air into the combustion chamber is derived from the same source as the air flow to the engine.

The invention also provides an internal combustion engine having an air inlet introducing combustion air into the engine, exhaust gas outlet means from the engine, compressor means for generating an air flow to the engine, turbine means for operating the compressor, and a combustion unit providing a flow of gas for operating the turbine means, the combustion unit having a combustion chamber with an inlet communicating with the exhaust gas outlet means of the engine, air inlet means for admitting air to the chamber whereby the exhaust gas and the air are caused to mix and combust within the chamber, gas outlet means from the chamber communicating with the turbine means whereby the flow of gases from the outlet means drives the compressor.

Preferably, the engine comprises duct means for directing a flow of air from the compressor to the air inlet means of the combustion chamber and flow control means for controlling the rate of flow of said air to the chamber.

In another aspect of the invention there is provided a method of operating an internal combustion engine wherein air for operating the engine is directed by a compressor into the engine, exhaust gases from the engine are directed into a combustion chamber, air is also directed into the combustion chamber, and the rate of fuel flow to the engine and rate of air supply to the engine are arranged to ensure that combustible products are discharged with the exhaust gas, the combustible products in the exhaust gas are mixed with the air to cause combustion within the combustion chamber, the products of combustion are caused to be discharged as a rapid flow from the chamber to turbine drive means to drive the compressor and the compressor is caused to direct the flow of air to the engine.

Further features of the invention will appear from the following description of an embodiment of the invention given by way of example only and with reference to the drawings, in which:

Fig. 1 is a schematic drawing of an internal combustion engine incorporating a turbocharger unit, and

Fig. 2 is a longitudinal section through a combustion chamber of the turbocharger.

Referring to the drawings and firstly to Fig. 1, there is shown an internal combustion engine 10 which may be of any convenient form, in this case a four cylinder petrol engine. The engine 10 has an inlet manifold 11 by which air is introduced into the combustion chambers of the engine 10 and an exhaust manifold 12 by which the products of combustion in the engine 10 are collected and discharged to an exhaust outlet 13.

A turbocharger combustion chamber 15 is fed with the exhaust from the engine 10, with air from an inlet 16, and discharges gas from an outlet 17 to drive a turbine 23. Gas is exhausted from the turbine 23 to an exhaust pipe 19 and a compressor 18 on a common shaft 24 to the turbine 23 draws in air through an air inlet 20 for compression

and discharge through a high pressure inlet duct 21. The air in the duct 21 is directed towards the inlet manifold 11 of the engine 10 and, in addition, a controlled amount of air passes from the duct 21 to the duct 16, control of flow of such air to the turbocharger combustion chamber 15 being by a control valve 22.

In general terms, the engine shown in Fig. 1 operates in a conventional manner by air from the manifold 11 being introduced into the engine 10 with measured amounts of fuel for combustion within the combustion chambers. Exhaust gases from the engine combustion chambers passes out along the exhaust manifold 12 to the chamber 15 in which the products of combustion are mixed with air from duct 16. Combustion of combustibles from the exhaust manifold takes place within the chamber 15 thereby causing the discharge of high velocity gas from the outlet 17 to drive the turbine 23 and hence the compressor 18, operation of which causes high pressure air to be introduced to the inlet manifold 11 although part of the air is diverted by the control valve 22 to the turbocharger combustion chamber 15 for efficient burning of the combustibles therein.

The internal combustion engine is run in such manner that there are combustibles in the exhaust manifold 12 and such combustibles are able to be combusted in the chamber 15. The way in which the presence of combustibles in the chamber 15 is achieved is various since it depends on the nature of the engine 10 and how much boost from the turbocharger unit is required. In one arrangement there may be an excess of fuel provided to the engine to ensure that combustibles are present in the exhaust outlet and such excess fuel may be, for example, less than 15%.

It may also be found advantageous to introduce combustibles into the chamber 15 from another source than the exhaust manifold but this is not usually necessary. If introduction of combustible material is called for, it may be introduced directly to the inlet of the combustion chamber in the form of gas or vaporised fuel.

A high rate of combustion can be achieved within the combustion chamber 15 giving the compressor 18 a constant and flexible power source and supplying high pressure combustion air to the engine 10.

Referring now, in particular, to Fig. 2, the turbocharger combustion chamber is shown. The chamber 15 is of generally circular section and exhaust gases from the engine 10, including combustible products, are introduced in direction A to the inlet end of the chamber 15. Pressurised air is introduced to the chamber 15 in direction B along the air inlet duct 16.

The chamber 15 has various regions which, following the downstream direction, include an inlet region X, an annulus region Y and an outlet region Z. The inlet region X increases in cross-sectional area from the inlet 13 in the downstream direction, and the annulus region Y is of generally annular shape and constant cross-section. Over the outlet region Z, the cross-section tapers inwards to the outlet 17.

The chamber 15 is double-walled to define an inner wall 25 which is the peripheral wall of the chamber including regions X, Y and Z. There is an outer wall 27 of the chamber 15 which is spaced from the inner wall 25 to define a space 28 which is a chamber around which air introduced to the combustion chamber passes before being admitted into the chamber in which combustion takes place.

Over the region X openings 30 are formed in the wall 25 to admit air from the chamber 28 into the region X, there being a plurality of openings 30 over both an entry area of the region X and a downstream outwardly tapered area X1 leading to the annular region Y.

At the boundary between the region X and the region Y is located a baffle or obstruction member 32 which is located centrally and presents a baffle surface directed towards the inlet 13. The baffle 32 is carried on one end of a central hollow elongate member 34 which extends longitudinally of the region Y and whose interior is in communication with the chamber 28 to admit air from the chamber 28 along the

member 34 towards the baffle 32. The elongate member 34 has a plurality of outlet openings 35 for directing such air into the region Y.

The baffle 32 is secured to the inner walls 25 of the chamber by arms 36 which are displaced at 120 degrees from one another about the centre of the baffle 32 to be secured at their outer ends to the wall 25.

It will be seen that there is defined around the member 34 in the region Y, an annular space into which gas flowing through the chamber is directed by the baffle 32. At the transition between the inlet region X and the annular region Y, there are located directional air inlet pipes 38 which are arranged to direct air into the annular space in a directional manner, as shown. Further air is directed into the annular space from directional air outlets 40 which are directed tangentially, in the same direction, to the inner walls of the region Y.

Downstream of the annular region Y is the outlet region Z which tapers inwardly towards the outlet 17 and there is also provided a plurality of openings 42 for discharging air into the region Z, such air being provided to complete the combustion of combustibles within the chamber 15, the chamber 15 being arranged so that, as far as possible, the combustibles entering the chamber are fully burned by the time the gases leave through the outlet 17. Such gases reach a high velocity in leaving the chamber 15 to ensure that in acting on the turbine 23, the gases drive the compressor at a high speed and give significant boost of air to the engine.

During operation, gases entering the chamber at A are mixed with air entering through outlets 30 and combustion of the combustibles takes place. The incoming gases and air are directed outwards by the baffle 32 and are further mixed with air from the outlets 38 and there are set up burning toroidal vortices of gas and air within the annular region Y. Their formation and progression through the region Y is assisted by air being admitted from outlets 40 in the outer wall of the chamber and the outlets 35 in the elongate member 34. The vortices progress along the region Y until they reach the

outlet region Z. In this region further air is mixed from the outlet 42 resulting in a high velocity stream of gases discharging through the outlet 17.

The turbocharger combustion chamber 15 may, instead of relying upon combustibles being present in the exhaust gases, be provided with additional combustible material at or around the inlet 13, which material may be combustible gas, or vaporised fuel. The temperature of the exhaust gases entering the chamber 15 will be hot, for example, in the region of 1000 °C, so that the combustible material self ignites entering the chamber but ignition means may be provided, if required, for example in the form of a spark plug.

Instead of there being provided a jacket around the combustion chamber through which air is distributed to the various outlets, the air may be distributed through a series of pipes.

It will be appreciated that the turbine 23/ compressor unit 18 may take a conventional form, but arranged to be suited to the inlet temperatures of the gases from the chamber 15 which may be at a temperature of around 750 °C.

The turbocharger unit of the invention may find application in a wide range of engines on which turbocharger units have conventionally been fitted and the unit may provide a means of controlling the gaseous emissions from the engine. The combustion unit or turbocharger may also find application in an arrangement in which the exhaust gases from the engine are not fed to the unit, the unit relying on the supply of air and combustible material to the inlet 13. In this arrangement the unit is still associated with a turbine/compressor to deliver a flow of air either to an internal combustion engine or equipment which requires a supply of compressed air, such as a furnace.

In a further embodiment the combustion unit may find application in controlling the emissions of an internal combustion engine without being associated with a turbine/compressor unit. In such arrangement the engine exhaust gases are supplied to the combustion unit together with a supply of air. The outlet from the unit is connected

to the engine exhaust system. This may ensure more efficient operation of a catalytic converter in the exhaust system, giving rapid light-off without electric heating.

Claims

1. Turbocharger unit for an internal combustion engine, the unit comprising a combustion chamber having an inlet for admitting exhaust gases from the internal combustion engine, an air inlet for admitting air into the chamber, and an outlet in communication with a turbine whereby to cause the gases from the chamber to drive a compressor, operation of the compressor generating a flow of air to the internal combustion engine, the chamber being arranged to cause combustion within the chamber of combustible products of the engine exhaust and/or other combustible products introduced into the chamber.

2. A turbocharger unit according to claim 1 wherein the chamber is arranged to have an exhaust gas inlet region which increases in cross section in the downstream direction, a central obstruction member downstream of the inlet region, a central elongate member downstream of the obstruction member and extending generally in the direction of flow of gases through the chamber and having air outlet means for introducing air into the chamber.

3. A turbocharger unit according to claim 2 comprising a plurality of peripheral air outlet means whereby air is discharged at the outer periphery of the chamber.

4. A turbocharger unit according to claim 1, 2, or 3, wherein the chamber reduces in cross section towards the outlet.

5. A turbocharger unit according to any one of the preceding claims wherein the combustion chamber is formed with an outer air chamber from which the air is arranged to pass into the combustion chamber from a plurality of openings.

6. A turbocharger unit according to claim 2 wherein the central elongate member extends along the combustion chamber from the obstruction member towards the outlet end of the chamber and air is discharged from said chamber into a combustion space in

the combustion chamber, the space extending generally annularly around the elongate member.

7. A turbocharging unit according to any one of the preceding claims wherein the combustion chamber is generally circular in internal cross-section and defines a generally annular region downstream from the exhaust gas inlet in which combustion takes place, air being introduced into the annular region from radially inner and outer locations.

8. A turbocharger unit according to any one of the preceding claims wherein air is introduced through the walls of the combustion chamber in the region of the exhaust gas inlet and in the region of the exhaust gas outlet.

9. A turbocharger unit according to any one of the preceding claims wherein the flow of air into the chamber is controlled and derived from the same source as the air flow through the engine.

10. An internal combustion engine having an air inlet introducing combustion air into the engine, exhaust gas outlet means from the engine, compressor means for generating an air flow to the engine, turbine means for operating the compressor, and a combustion unit providing a flow of gas for operating the turbine means, the combustion unit having a combustion chamber with an inlet communicating with the exhaust gas outlet means of the engine, air inlet means for admitting air to the chamber whereby the exhaust gas and the air are caused to mix and combust within the chamber, gas outlet means from the chamber communicating with the turbine means whereby the flow of gases from the outlet means drives the compressor.

11. An internal combustion engine according to claim 10 comprising duct means for directing a flow of air from the compressor to the air inlet means of the combustion chamber and flow control means for controlling the rate of flow of said air to the chamber.

12. A method of operating an internal combustion engine wherein air for operating the engine is directed by a compressor into the engine, exhaust gases from the engine are directed into a turbocharger combustion chamber, air is also directed into the combustion chamber, and the rate of fuel flow to the engine and rate of air supply to the engine are arranged to ensure that combustible products are discharged with the exhaust gas, the combustible products in the exhaust gas are mixed with the air to cause combustion within the combustion chamber, the products of combustion are caused to be discharged as a rapid flow from the chamber to a turbine which drives the compressor and the compressor is caused to direct the flow of air to the engine.

13. Turbocharger unit comprising a combustion chamber having inlet means for admitting air and combustible material into the chamber, and an outlet in communication with a turbine whereby to cause the gases from the chamber to drive the turbine which is arranged to drive a compressor, operation of the compressor generating flow of air, the chamber being arranged to cause combustion within the chamber of the combustible material, the chamber having, in a downstream direction, an inlet region, an annular region, and an outlet region which are fed with air from the margins of said regions.

Turbocharger Boost Maintenance System

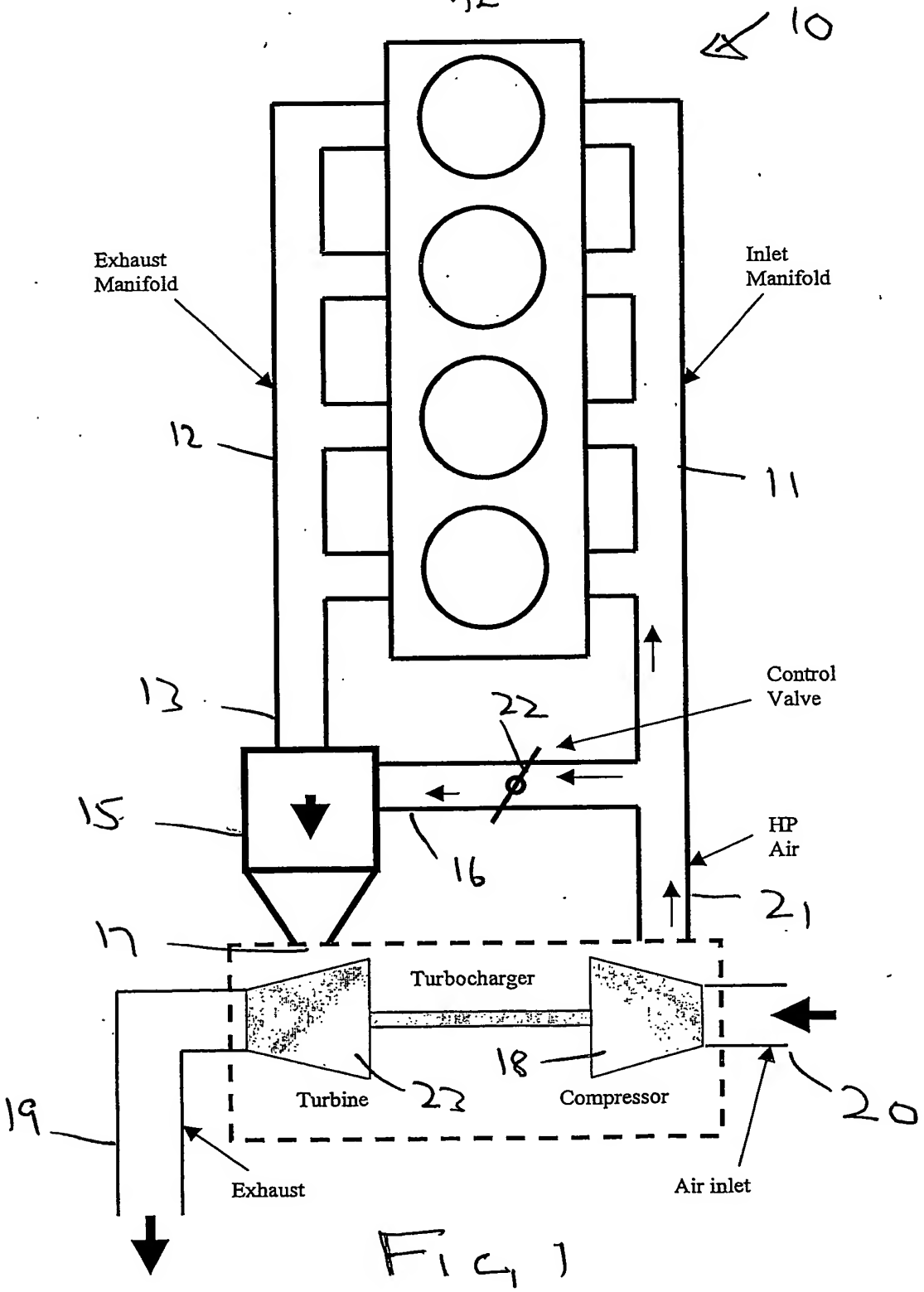

Fig 1

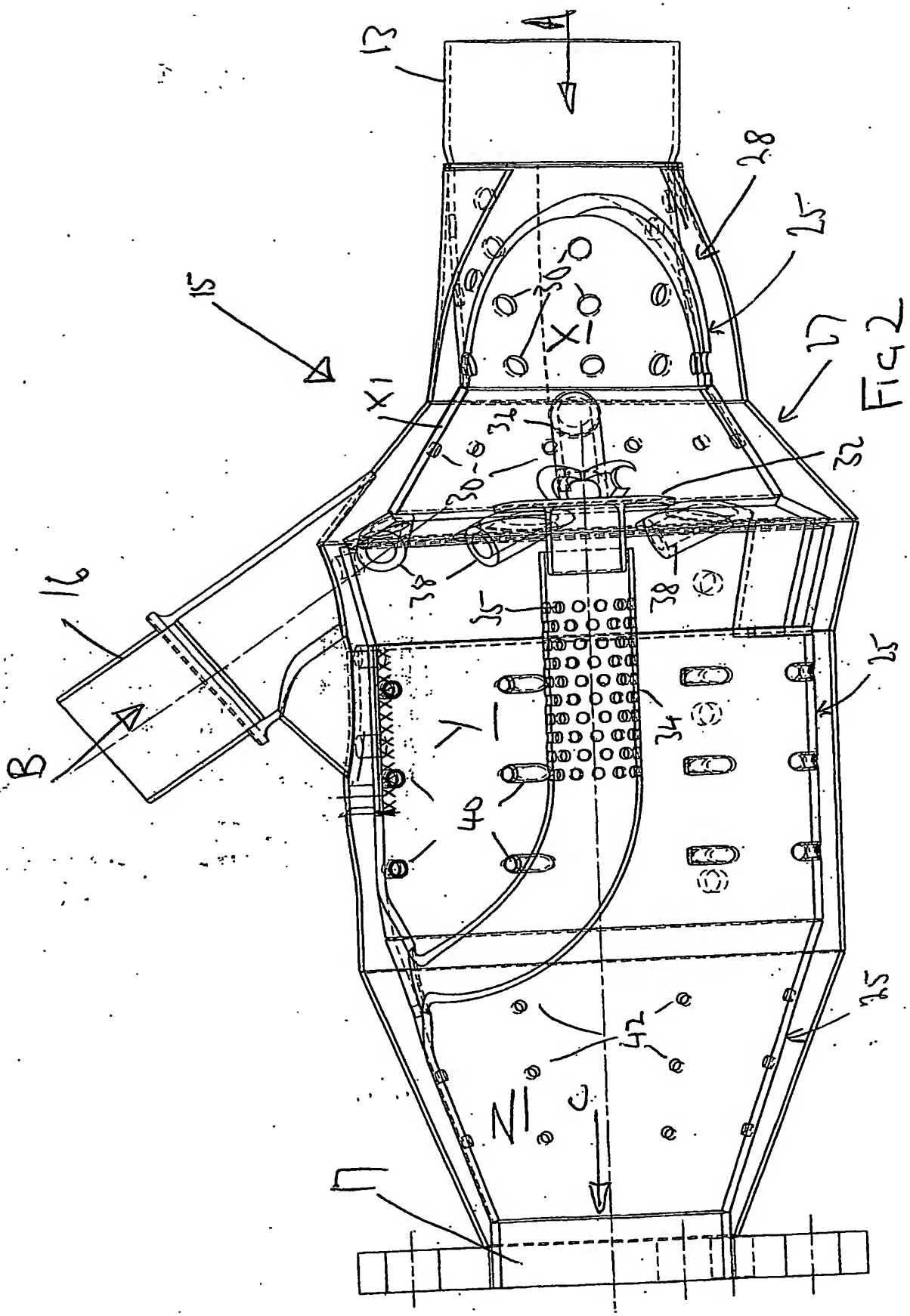

Fig 2